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International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : A23L 1/29	A2	(11) International Publication Number: WO 97/07690
		(43) International Publication Date: 6 March 1997 (06.03.97)

(21) International Application Number: PCT/US96/13663

(22) International Filing Date: 23 August 1996 (23.08.96)

(30) Priority Data:
08/518,748 24 August 1995 (24.08.95) US

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(81) Designated States: AU, BR, CA, NZ, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
Without international search report and to be republished upon receipt of that report.

(54) Title: CARBOHYDRATE AND MEDIUM CHAIN TRIGLYCERIDE GEL AS AN ENERGY SUPPLEMENT

(57) Abstract

An edible food gel for use as an energy supplement that includes one or more carbohydrates and one or more medium chain triglycerides.

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CARBOHYDRATE AND MEDIUM CHAIN TRIGLYCERIDE GEL AS AN ENERGY SUPPLEMENT

BACKGROUND OF THE INVENTION

The present invention relates to a food gel packaged in a flexible pouch. packet or tube, and more particularly, to a carbohydrate based food gel.

Serious athletes participating in long duration exercises such as triathlons, ultra running events, cycling stage races, endurance swimming events, etc., or even weekend athletes participating in shorter exercise events, find themselves in need of energy supplements during the exercise routine. A variety of energy supplements, including sport drinks, solid foods, and concentrated viscous liquids, such as gels, have been developed in attempting to meet the energy needs of athletes.

Sport drinks are the most popular supplemental energy product. However, sport drinks provide only a small, supplemental amount of calories, when used alone, and are not an adequate energy supplement for athletic activity which occurs over an extended period, such as an hour or longer. Also, while sport drinks help to slow the loss of energy, sport drinks generally do not stem this loss entirely. Accordingly, many athletes attempt to refuel with solid foods, such as fruit or candy bars, that have a higher caloric content. Unfortunately, these solid foods tend to be messy and difficult to use when competing or participating in an athletic activity. Solid foods typically must be unwrapped prior to use. Solid foods usually require considerable chewing prior to ingestion. Additionally, most solid foods are slow to liquify in the stomach, which slows the body's caloric absorption during digestion of the food in the digestive tract.

Gelled food products ("food gels") are an alternative to both sport drinks and solid foods. Food gels may be formulated to be rich in calories that are quickly and easily digestible during athletic activity. Food gels are typically

provided in flexible pouches, packets, or tubes that may be squeezed directly into the athlete's mouth to deliver a predetermined gel serving size to the athlete.

There are currently several gelled food products available on the market. Sports Street Marketing Company of Berkeley, California markets a sports gel under the "GU" product name. This food gel is prepared using maltodextrin, fructose and water. Minerals, electrolytes, flavors, herbs, vitamins and preservatives are also included in this food gel. Two carbohydrates are the only caloric source of the "GU" food gel. Several amino acids are included in the ingredient listing that accompanies the "GU" food gel. However, the product label of the "GU" food gel states that the "GU" food gel contains no protein. It is therefore believed that the amount of protein in the "GU" food gel is de minimis and provides no measurable energy. The "GU" food gel is packaged in a flexible, tear-top pouch.

Sports Pep Company of Castle Rock, Colorado markets a food gel under the "POCKET ROCKET" product name. This food gel is prepared using maltodextrin, fructose and water. Minerals, electrolytes, flavors, herbs and preservatives are also included in this food gel. No protein is added to this food gel. Two carbohydrates are the only caloric source of the "POCKET ROCKET" food gel, which is packaged in a flexible, tear-top pouch.

Leppin Company of the United Kingdom markets a food gel under the "SQUEEZY" product name. This gel is prepared using maltodextrin, water and dextrose. No protein is added to this food gel. Two carbohydrates are the only caloric source of the "SQUEEZY" food gel, which is packaged in a flexible, tear-top pouch.

Quaker Oats/Gatorade of Chicago, Illinois markets a food gel under the "RELODE" name. This gel is prepared using maltodextrin, water and dextrose. Minerals, electrolytes and preservatives are also included in this food gel. No protein is added to this food gel. Two carbohydrates are the only

caloric source of the "RELODE" food gel, which is packaged in a flexible, tear-top pouch.

Food gels provide athletes with enhanced calorie density, as compared to sports drinks. Food gels provide athletes with an easily dispensed product, as compared to solid foods. Food gels digest more quickly and easily than most solid foods because food gels do not require significant chewing and because food gels liquify more quickly in the stomach than most solid foods. Despite the benefits of existing food gels, further advances in food gel technology are needed to provide quicker and more efficient calorie delivery to the athlete while minimizing undesirable calorie delivery effects, such as deposition of body fat and shifts in blood insulin and glucose levels.

SUMMARY OF THE INVENTION

The present invention includes a food gel that may be used as an energy supplement. The food gel includes one or more carbohydrates and one or more medium chain triglycerides. The present invention also includes a method of making the food gel.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention includes a food gel that may be used as an energy supplement and also includes a method of making the food gel. The food gel includes a carbohydrate base and either one medium chain triglyceride (hereinafter referred to as "MCT") or a mixture of medium chain triglycerides (MCTs). The inventive food gel may be packaged in a squeezable pouch or packet (not shown) using conventional packaging techniques. The food gel may be squeezed from the pouch or packet to deliver a predetermined amount of food gel directly into an athlete's mouth. The food gel provides quick supplemental energy for athletes in a convenient and easy to use form. The food gel is especially beneficial for those athletes who engage in long duration events or exercise.

As mentioned, the inventive food gel includes one or more medium chain triglycerides. A triglyceride is a fat molecule that includes three molecules of fatty acid that are held in ester linkage to glycerol. A medium chain triglyceride (MCT) is a triglyceride that includes C_6-C_{12} fatty acid molecules. The inventive food gel may included from about 4% to about 25% medium chain triglyceride by weight.

When the food gel of the present invention includes only a single MCT, the MCT may include any suitable combination of C_6-C_{12} fatty acid molecules. When the food gel of the present invention includes a mixture of MCTs, the various MCTs may each include any suitable combination of C_6-C_{12} fatty acid molecules. Based on the total weight of the fatty acids included in the mixture of medium chain triglycerides, the fatty acids of the medium chain triglycerides preferably include from about 1% to about 2% C_6 fatty acids by weight, from about 65% to about 75% C_8 fatty acids by weight, from about 25% to about 35% C_{10} fatty acids by weight, and from about 1% to about 2% C_{12} fatty acids by weight. Mixtures of MCTs are readily available in the market and

are sold, for example, by Henkel Corporation of La Grange, Illinois under the "DELIOS S" product name and by the Stepan Company of Maywood, New Jersey under the "NEOBEE M-5" product name.

In addition to the medium chain triglyceride or mixture of medium chain triglycerides, the inventive food gel also includes a carbohydrate base. The carbohydrate base may include any of a broad spectrum of carbohydrates in liquid and/or powder form. The carbohydrates supplement the beneficial effects of medium chain triglyceride in that the carbohydrates produce a sustained elevation of glucose levels in the blood. The carbohydrates may be derived from any suitable source, such as grains. Some examples of suitable carbohydrates include polysaccharides, such as rice, corn, potato, wheat and barley starches and dextrins. Other examples of suitable carbohydrates include sugars, such as monosaccharides, including glucose and fructose; disaccharides, including sucrose; and trisaccharides.

The carbohydrates included in the food gel preferably are blended to provide a range of carbohydrate chain lengths extending from monosaccharides to pentasaccharides, decasaccharides and longer chain polysaccharides. The range of carbohydrate chain lengths included in the food gel is preferably distributed in the shape of a bell curve so that muscle cramping is not induced upon digestion of the food gel carbohydrates.

The carbohydrate base preferably is a mixture that includes a first rice syrup and a second rice syrup. The first rice syrup preferably has a dextrose equivalent ("DE") ranging from about 20 to about 35, and the second rice syrup preferably has a DE ranging from about 30 to about 50. Dextrose equivalent ("DE") is a well-known food industry standard for measuring the percentage of glucosidic bonds of the carbohydrate that are hydrolyzed. In a carbohydrate with a dextrose of equivalent of 100, 100% of the glucosidic bonds of the carbohydrate are hydrolyzed. In a carbohydrate with a dextrose of equivalent of

20, 20% of the glucosidic bonds of the carbohydrate are hydrolyzed. In one embodiment, the first rice syrup has a DE of about 30 and forms about 40.75% of the total weight of the food gel, and the second rice syrup has a DE of about 42 forms about 40.75% of the total weight of the food gel. Rice syrups with dextrose equivalents of about 30 and about 42 are available from Malt Products Corporation of Saddle Brook, New Jersey.

MCT provide a number of important benefits to the inventive food gel. For example, the caloric density of MCT (8.3 kcal/gram) is more than twice the caloric density of carbohydrates and proteins (about 3 to about 4 kcal/gram). Thus, on a weight basis, MCTs are known to deliver more than twice the energy (expressed in calories) of carbohydrates and proteins (gram for gram) upon digestion in the body.

The molecular size of MCTs permits rapid hydrolysis of MCTs by pancreatic lipase in the intestinal mucosa of the digestive system to predominantly form medium chain fatty acids (MCFAs). MCFAs formed on hydrolysis of MCTs are relatively soluble in water (about 68 mg/100ml at 20°C for C_8 fatty acids). The solubility of MCFAs in biological fluids is further enhanced by the fact that MCFAs are weak electrolytes and are highly ionized at neutral pH. The result is that MCFAs formed on hydrolysis of MCTs are relatively rapidly absorbed in the digestive system at approximately the same rate as glucose.

The relatively rapid solubilization of MCFAs causes the MCFAs to be transported directly to the liver from the intestinal mucosa via the portal venous system, as opposed to the extrahepatic tissues. Since the MCFAs travel directly to the liver, MCFAs have a very low tendency to deposit as body fat. Also, since the MCFAs, unlike long chain fatty acids, travel directly to the liver, the energy derived from MCT is provided through a metabolic pathway that does not compete with carbohydrate metabolism. The MCFAs are rapidly oxidized

in the liver into ketone bodies that are rapidly transported to and utilized as energy by the extrahepatic tissues, such as muscles, of the body. Ingestion and digestion of MCTs therefore provides a rapid source of energy to the liver, via the oxidation of MCFAs, and also provides a rapid source of energy to other body tissues that utilize the ketone bodies. Also, MCTs cause little if any changes in body insulin levels because MCTs, and products derived by digestion of MCTs, elicit virtually no insulin response from the body.

Other benefits result from incorporation of MCTs in the food gel. For example, MCTs included in the body appear to improved absorption of amino acids derived from protein. Also, calcium and magnesium absorption appears to be enhanced when the diet includes MCTs. Additionally, it appears that MCTs improve the body's tolerance for carbohydrates.

Carbohydrates are incorporated in the inventive food gel for a couple of reasons. First, complete hydrolysis of carbohydrates in the digestive system produces glucose. Glucose enhances the oxidation of MCFAs in the liver into ketone bodies. Thus, ingestion of carbohydrates along with MCTs tends to enhance the rate and extent to which MCFAs derived from MCTs are transformed into energy-rich ketone bodies. Thus, the combination of both MCTs and carbohydrates in the food gel provides an energy supplement with surprisingly beneficial characteristics. For example, the inventive food gel has a higher caloric density than food products that include carbohydrates, but not MCTs. Also, the inventive food gel is more quickly and fully converted into ketone bodies, as compared to a food product that includes MCTs, but not carbohydrates. Another reason for combining MCTs and carbohydrates in the inventive food gel is that MCTs do not have a very pleasing taste. Combination of carbohydrates with MCTs enhances the palatability of the food gel that incorporates MCTs.

The method of making the inventive food gel includes two primary steps, (1) preparation of an MCT premix, (2) combination of the carbohydrate base and the MCT premix to form the food gel. The MCT premix is prepared by adding an emulsifier to the medium chain triglyceride or mixture of medium chain triglycerides. The emulsifier and the triglyceride(s) are blended in a conventional high shear mixer until the emulsifier is fully dissolved in the triglyceride(s).

The emulsifier may be any suitable natural emulsifying agent, such as lecithin or glycerol. The emulsifier is preferably de-oiled lecithin, such as is available from the Central Soya Co., Inc. of Fort Wayne, Indiana under the "Centrolex" product name. The emulsifier is used to suspend the MCTs in the carbohydrate base because MCTs take the form of oils and carbohydrates are insoluble in oil. Therefore, it is difficult to directly mix the MCTs with the carbohydrates to form a homogeneous mixture.

The MCT premix generally makes up from about 8% to about 25% of the total weight of the food gel. Preferably, the MCT premix includes from about 5% to about 15% of lecithin, by weight, and from about 85% to about 95% of the mixture of MCTs, by weight.

The food gel is formed by combining the MCT premix with the carbohydrate base. The carbohydrate base is created by first separately heating each carbohydrate that is to be included in the carbohydrate base. The carbohydrate base can include one or more different carbohydrates. The first rice syrup and the second rice syrup are examples of suitable carbohydrates. The carbohydrates are heated to a temperature in the range of from about 110°F (about 43°C) to about 130°F (about 54°C). It is important that the carbohydrate not be heated to a temperature of greater than about 140°F (about 60°C) since heating to a temperature greater than about 140°F (about 60°C) may make the food gel undesirably dark. When the carbohydrate base includes two or more

carbohydrates, the heated carbohydrates are combined to form the carbohydrate base.

After formation of the carbohydrate base, the food gel is formed by combining the carbohydrate base, which should still be from about 110°F (about 43°C) to about 130°F (about 54°C), with the MCT premix in a large mixing container. The MCT premix and the carbohydrate base are homogeneously mixed for about 10 minutes to obtain the food gel. A small amount of water may be added to the carbohydrate base along with the MCT premix to enhance mixing and reduce the viscosity of the food gel.

It is contemplated that other substances may be added to the food gel. These other substances may be added to the food gel after the MCT premix and the carbohydrate base are homogeneously mixed. When other substances are added, the food gel should be mixed for an additional period of about 15 minutes to ensure homogenous mixture of the other substances into the food gel. Examples of these other substances include natural flavors, citric acid, vitamins, herbs, protein, and minerals and electrolytes. Still other substances may also be added may to suit particular needs.

The natural flavors are added to the food gel to improve the taste and palatability of the food gel. If the natural flavors are included, the natural flavors may make up from about 0.10% to about 1.00% of the total weight of the gel. The citric acid may be added to the food gel to increase the acidity (to lower the Ph) of the food gel to lengthen the shelf life of the food gel and improve the taste of the food gel. If included, the citric acid may make up from about 0.10% to about 0.50% of the total weight of the food gel, and in the preferred embodiment is approximately 0.20% by weight of the gel. One suitable form of Citric acid is available from Hoffman-La Roche, Inc. of Nuttley, New Jersey as "USP/FCC anhydrous - Fine Granular" citric acid.

Vitamins may be added to the food gel as fortifiers. The vitamins enhance the overall food value of the food gel and are especially useful for longer duration exercise where a more complete food would be beneficial. Herbs may also be added to the food gel as fortifiers to enhance burning of fat to provide thermogenic benefits, such as additional energy. One example of a suitable herb is guarana, which contains naturally occurring caffeine, a known thermogenic agent.

Protein may be added to the food gel to enhance the overall food value of the gel for longer duration exercise where a more complete food would be beneficial. Examples of suitable protein sources include food sources, such as egg albumin and dairy or soy products; hydrolyzed (digested) proteins, such as lactalbumin and casein; and amino acids. Incorporation of protein into the food gel preferably occurs when the duration of the exercise is expected to last 2-24 hours and when solid food feeding is inconvenient or difficult. The addition of protein enhances the energy value and helps prevent spare muscle tissue catabolism. Muscle tissue catabolism entails deterioration of muscle tissues due to combustion of muscle tissue to meet energy needs. The addition of protein also provides amino acid building blocks that are necessary for tissue repair.

Addition of minerals and electrolytes to the food gel helps to replace sweat-based mineral and electrolyte losses that occur during long duration exercise. Replacement of minerals and electrolytes is important as electrolyte imbalance and mineral deficiency each reduce muscle efficiency. The minerals and electrolytes may be readied for incorporation into the food gel by first preparing a mineral/electrolyte premix that includes one or more mineral and electrolyte components. Some examples of suitable mineral and electrolyte components include sodium chloride, potassium chloride, and magnesium oxide. The mineral and electrolyte components may be combined in the

mineral/electrolyte premix using a standard power mixer. The mineral and electrolyte components of the premix are mixed for 15 minutes until complete dispersion and distribution of all the components is achieved. Then the mineral/electrolyte premix may be added to the food gel. If included, the mineral/electrolyte premix makes up from about 0.10% to about 1.00% of the total weight of the food gel.

In one preferred formulation, the MCT premix has the composition described in Table I and the Mineral/Electrolyte premix has the composition described in Table II:

TABLE I

INGREDIENTS	PERCENT BY WEIGHT IN THE MCT PREMIX
Medium Chain Triglycerides ("Delios S" product of Henkel Company)	89.5%
De-oiled Lecithin ("Centrolux" Product of Central Soya Co, Inc)	10.5%

TABLE II

INGREDIENTS	PERCENT BY WEIGHT IN THE MINERAL/ELECTROLYTE PREMIX
Sodium Chloride	39.99%
Potassium Chloride	39.99%
Magnesium Chloride	20.02%

In one preferred formulation of the food gel, the food gel has the composition described in Table III, where the MCT Premix has the formulation described in Table I and where the Mineral/Electrolyte premix has the composition described in Table II:

TABLE III

INGREDIENTS	PERCENT BY WEIGHT IN THE FOOD GEL
Rice Syrup (30 DE) (available from Malt Products Corp.)	40.75%
Rice Syrup (42 DE) (available from Malt Products Corp.)	40.75%
MCT Premix (Table I Formulation)	11.70%
Water	6.165%
Natural Flavors	0.30%
Citric Acid ("USP/FCC Anhydrous - Fine Granular" product of Hoffman-La Roche, Inc.)	0.20%
Mineral/Electrolyte Premix (Table II Formulation)	0.135%

A conventional form, fill and seal machine, such as available from Circle Design Corporation, may be used to package the food gel into flexible pouches. One version of the pouch is about 2.5 inches x 5.5 inches (about 6.35 cm x 14 cm) and contains a serving size of the food gel of approximately 37-38 grams. It is anticipated that a single packaged serving of approximately 37-38 grams of the food gel will have a total calorie content of from about 90 to about 150 calories using the aforementioned food gel formulations.

It is to be noted that the inventive food gel having the preferred formulation above or a similar formulation may be used by diabetic athletes involved in long duration exercise to help sustain even blood sugar (glucose) levels. This provides a significant benefit in alleviating the huge peaks and

valleys in blood sugar levels often experienced by diabetic athletes. For the long duration athlete, the present invention provides a simple and easy method for ingesting an energy formulation which provides quick and complete assimilation into the body. Along with the food gel, additional water may consumed by the athlete, as needed, to facilitate absorption of the food gel nutrients.

Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention.

WHAT IS CLAIMED IS:

1. A method of making a food gel usable as an energy supplement, the method comprising:

mixing one or more carbohydrates and one or more medium chain triglycerides.

2. The method of claim 1 wherein the medium chain triglycerides are triglycerides with fatty acid groups are each individually selected from the group consisting of C_6, C_8, C_{10}, and C_{12} fatty acid molecules.

3. The method of claim 1 wherein the medium chain triglycerides include from about 1% to about 2% C_6 fatty acids by weight, from about 65% to about 75% C_8 fatty acids by weight, from about 25% to about 35% C_{10} fatty acids by weight, and from about 1% to about 2% C_{12} fatty acids by weight.

4. The method of claim 1 wherein the carbohydrates are each individually selected from the group consisting of monosaccharide, disaccharide, trisaccharide, and polysaccharide.

5. The method of claim 4 wherein at least:

polysaccharide is selected from the group consisting of rice starch, corn starch, potato starch, wheat starch, barley starch, rice dextrin, corn dextrin, potato dextrin, wheat dextrin, barley dextrin and any mixture of these;

monosaccharide is selected from the group consisting of glucose, fructose, and any mixture of these; or

disaccharide is selected from the group consisting of sucrose..

6. The method of claim 1 wherein the carbohydrates comprise a first carbohydrate having a dextrose equivalent of from about 20 DE to about 30 DE and a second carbohydrate having a dextrose equivalent of from about 35 DE to about 50 DE.

7. The method of claim 1 wherein the range of chain lengths of carbohydrates is distributed in the shape of a bell curve.

8. The method of claim 1 wherein mixing one or more carbohydrates and one or more medium chain triglycerides comprises:

preparing a triglyceride premix; and

combining the triglyceride premix and the carbohydrates.

9. The method of claim 8 wherein the triglyceride premix includes from about 85% to about 95% medium chain triglycerides by weight.

10. The method of claim 8 wherein the food gel includes from about 8% to about 25% of the triglyceride premix by weight.

11. The method of claim 8 wherein preparing the triglyceride premix comprises mixing one or more medium chain triglycerides and an emulsifier.

12. The method of claim 1, and further comprising adding a nutritional supplement to the mixture of carbohydrate and triglyceride, the nutritional supplement selected from the group consisting of citric acid, an herb, a vitamin, a mineral, an electrolyte, a protein, and any mixture of these.

13. The method of claim 1 wherein mixing one or more carbohydrates and one or more medium chain triglycerides comprises:

preparing a triglyceride premix;

making a mixture of nutritional supplements, the nutritional supplements selected from the group consisting of citric acid, an herb, a vitamin, a mineral, an electrolyte, a protein, and any mixture of these; and

combining the triglyceride premix, the nutritional supplement mixture, and the carbohydrates.

14. A food gel made by the method of claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, or 13.

15. A flexible container that contains a food gel made by the method of claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, or 13.

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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :		(11) International Publication Number:
A23L 1/29, 1/09, 2/38	**A3**	**WO 97/07690**
		(43) International Publication Date: 6 March 1997 (06.03.97)

(21) International Application Number: PCT/US96/13663

(22) International Filing Date: 23 August 1996 (23.08.96)

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08/518,748 24 August 1995 (24.08.95) US

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(81) Designated States: AU, BR, CA, NZ, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(88) Date of publication of the international search report:
27 March 1997 (27.03.97)

(54) Title: CARBOHYDRATE AND MEDIUM CHAIN TRIGLYCERIDE GEL AS AN ENERGY SUPPLEMENT

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INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/US 96/13663

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A23L1/29 A23L1/09 A23L2/38

According to International Patent Classification (IPC) or to both national classification and IPC

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Minimum documentation searched (classification system followed by classification symbols)
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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DD 294 853 A (VEB BERLIN-CHEMIE) 17 October 1991 see the whole document	1-14
A	EP 0 395 865 A (NB INTERNATIONAL TECHNOLOGIES) 7 November 1990 see claims	1-14
A,P	EP 0 691 079 A (CLINTEC NUTRITION) 10 January 1996 see claims	1-14
A	EP 0 223 540 A (SPORTS DRINK) 27 May 1987 see claims	1-15
A	NL 9 301 251 A (G.M.E.JANSSEN ET AL.) 1 February 1995 see the whole document	1-14

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6 February 1997	20. 02. 97
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Form PCT/ISA/210 (second sheet) (July 1992)

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